22096009

International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

BIOLOGY
HIGHER LEVEL
PAPER 3

Thursday 7 May 2009 (morning)

1 hour 15 minutes

Candidate session number

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INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from two of the Options in the spaces provided. You may continue your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the letters of the Options answered in the candidate box on your cover sheet and indicate the number of answer sheets used in the appropriate box on your cover sheet.

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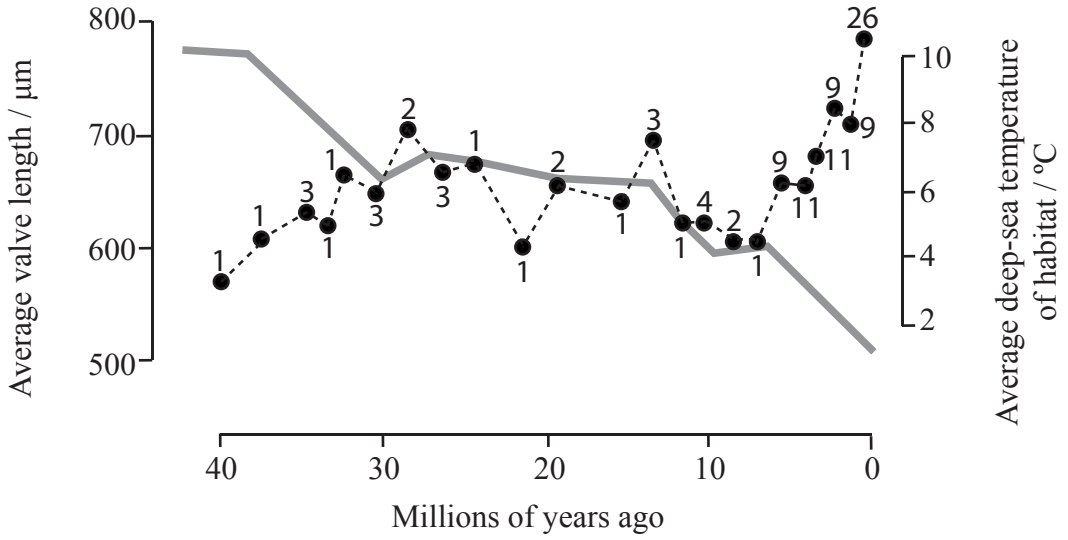
Option D — Evolution

D1. There is evidence that body size of animals tends to increase over time. In this study, fossils and living species from the genus *Poseidonamicus*, deep-sea ostracods, were used to test this hypothesis. The numbers on the dotted line represent the number of different *Poseidonamicus* species found either as fossils or living. For each time period, the average valve length of all species studied is plotted. Valve length is an indication of total body size. The continuous line is the estimated temperature of their deep-sea habitat.



[Source: Gene Hunt and Kaustuv Roy, "Climate change, body size evolution, and Cope's Rule in deep-sea ostracodes", Proceedings of the National Academy of Sciences, Volume 103, Issue 5, January 31 2006, pp. 1347–1352: Figure 1C. Copyright 2006 National Academy of Sciences, USA.]

(a) Calculate the percentage increase in valve length between the species studied from 40 million years ago and the species from the present day. *[2]*

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(b) Suggest **two** reasons for the increase in the number of species of *Poseidonamicus* over time. *[2]*

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(This question continues on the following page)

(Question D1 continued)

(c) Evaluate the hypothesis that changes in size of *Poseidonamicus* are caused by changes in sea temperature. *[3]*

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D2. (a) State **one** process needed for the spontaneous origin of life on Earth. *[1]*

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(b) Outline the contribution of prokaryotes to the creation of an oxygen-rich atmosphere. *[2]*

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D3. (a) Outline allopatric and sympatric speciation. *[4]*

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(b) Explain the biochemical evidence for the common ancestry of living organisms. *[6]*

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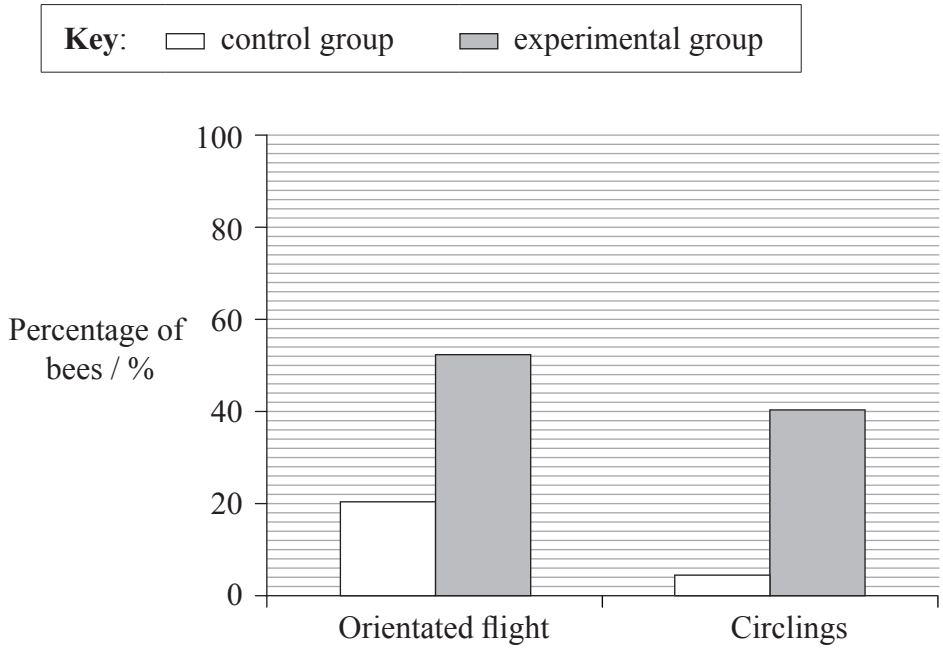
Option E — Neurobiology and behaviour

E1. Evidence suggests that the behaviour of bees is often a response to odours. Scientists placed bees 200 cm away from an attractive odour source. An experimental group of bees had previous exposure to the odour, a control group had no previous exposure. Both the percentage of bees flying towards (orientated flight) and the percentage circling the odour source were measured.



[Source: Antoine Chaffiol, David Laloi, and Minh-Hà Pham-Delègue, "Prior classical olfactory conditioning improves odour-cued flight orientation of honey bees in a wind tunnel", *Journal of Experimental Biology*, Volume 208, Issue 19, pp. 3731-3737 (Figure 3). Adapted with permission.]

(a) Describe the effect of previous exposure to the odour on the flight of bees. *[2]*

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(b) Outline the type of behaviour that the experimental group demonstrates. *[1]*

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(This question continues on the following page)

(Question E1 continued)

(c) Discuss the implications of this study for the survival of bees. *[3]*

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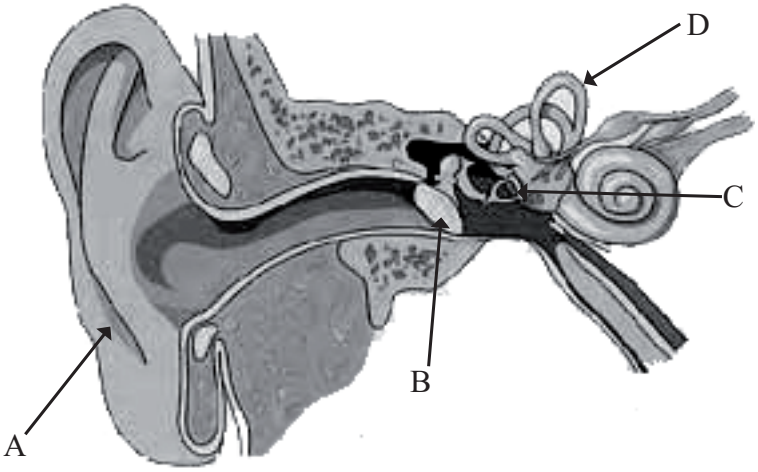
E2. (a) Label this diagram of the ear. *[2]*



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B. . . . . .

C. . . . . .

D. . . . . .

(b) (i) Define *reflex*. *[1]*

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(ii) List **two** inhibitory psychoactive drugs. *[1]*

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E3. (a) Describe an experiment investigating innate behaviour in invertebrates. *[4]*

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(b) Explain how fMRI (functional magnetic resonance imaging) scanning can be used in investigation of how the human brain functions. *[6]*

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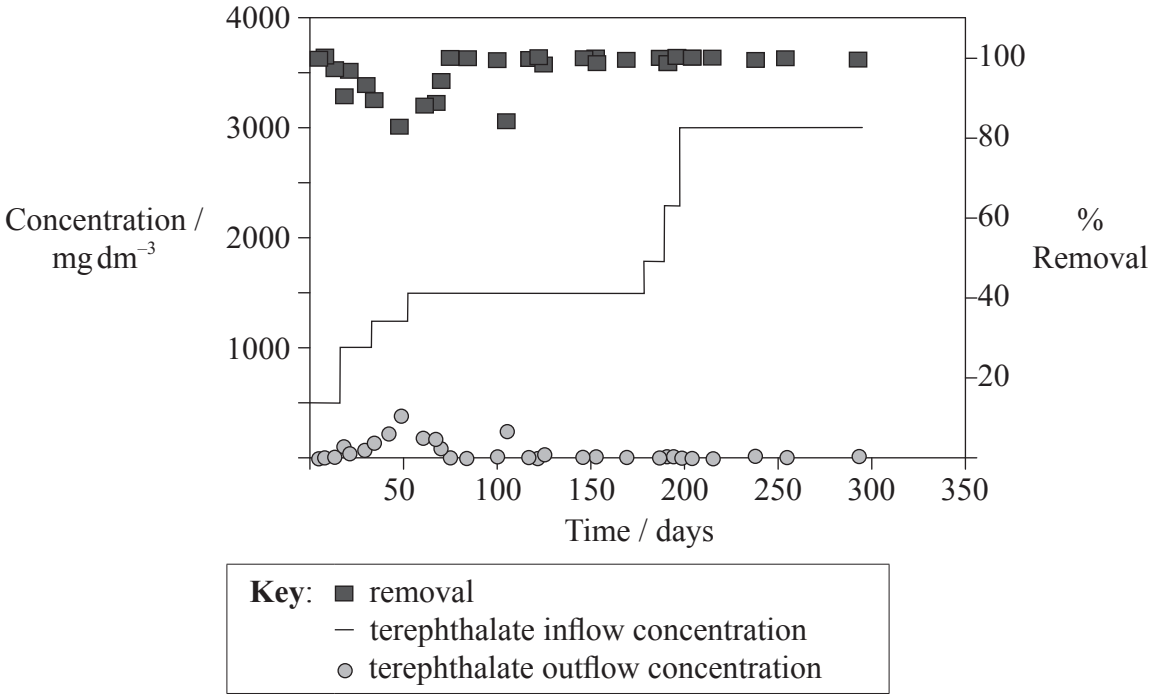
Option F — Microbes and biotechnology

F1. Wastewater from factories producing polyester fibres contains high concentrations of the chemical terephthalate. Efficient removal of this compound can be achieved by certain bacteria. The graph below shows what percentage of the compound can be removed from the wastewater in an experimental reactor. Researchers increased the amount of terephthalate entering the reactor stepwise over a 200 day period.



[Source: Jer-Horng Wu, Wen-Tso Liu, I-Cheng Tseng, and Sheng-Shung Cheng, "Characterization of microbial consortia in a terephthalate-degrading anaerobic granular sludge system", *Microbiology*, Volume 147 (2001), pp. 373-382, © Society for General Microbiology. Reprinted with permission.]

(This question continues on the following page)

(Question F1 continued)

(a) The reactor has a volume of 12 litres. Calculate the initial amount of terephthalate in the reactor. *[1]*

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(b) (i) Outline the relationship between terephthalate concentration in the outflow and percentage removal. *[2]*

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(ii) Suggest why the drop in removal percentage occurs. *[1]*

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(c) Deduce which bacteria can be used for the degradation of terephthalate. *[1]*

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(d) Evaluate the efficiency of the terephthalate removal. *[2]*

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F2. (a) State the roles of: *[1]*

Rhizobium: . . . . . .

Nitrosomonas: . . . . . .

(b) Outline the production of soy sauce. *[2]*

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F3. (a) Outline the diversity in structure of viruses. *[4]*

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(b) Discuss the origin and epidemiology of a pandemic. *[6]*

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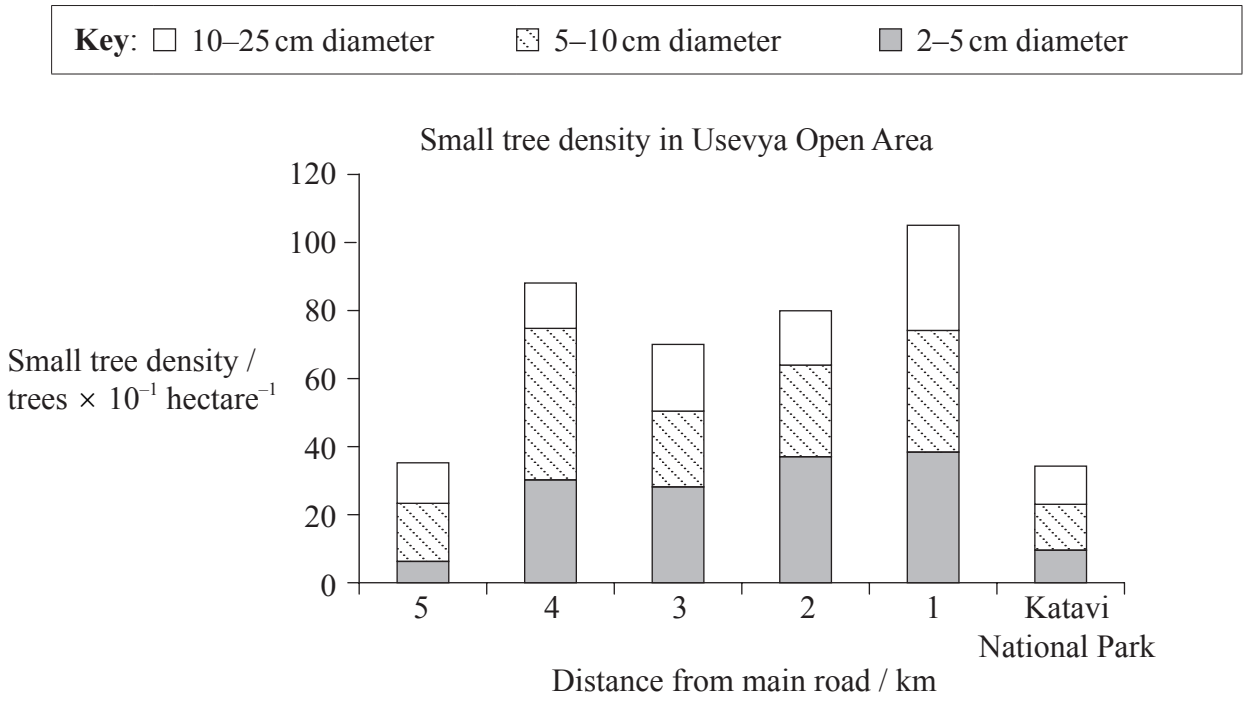
Option G — Ecology and conservation

G1. In south-central Africa trees are used for furniture production or building material by the local population. Large trees are cut down selectively. The densities of small trees were studied in Usevya Open Area where there are three settlements. Katavi National Park, where tree cutting is not allowed, is next to Usevya Open Area.

The graph below shows the density of three categories of small trees up to 25 cm in diameter at set distances from the main road.



[Source: M. W. Schwartz, T. M. Caro, "Effect of selective logging on tree and understory regeneration in miombo woodland in western Tanzania", *African Journal of Ecology*, Volume 41, Issue 1, pp. 75–82. Copyright Wiley-Blackwell. Reprinted with permission.]

(a) Identify the density of trees with a diameter between 5–10 cm in Usevya Open Area at a distance of 4 km from the main road. *[1]*

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(This question continues on the following page)

(Question G1 continued)

(b) In Usevya Open Area describe the relationship between distance from the main road and small trees. *[2]*

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(c) Outline the density of small trees in Usevya Open Area. *[1]*

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(d) Discuss the distribution of small trees in Katavi National Park with those at a distance of 5 km from the road. *[3]*

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G2. (a) Define *biomass*. *[1]*

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(b) Outline the effects of ultraviolet (UV) radiation on living tissues. *[2]*

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G3. (a) Describe the causes and consequences of a **named** example of biomagnification. *[5]*

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(b) Discuss conditions that favour K-strategies. *[5]*

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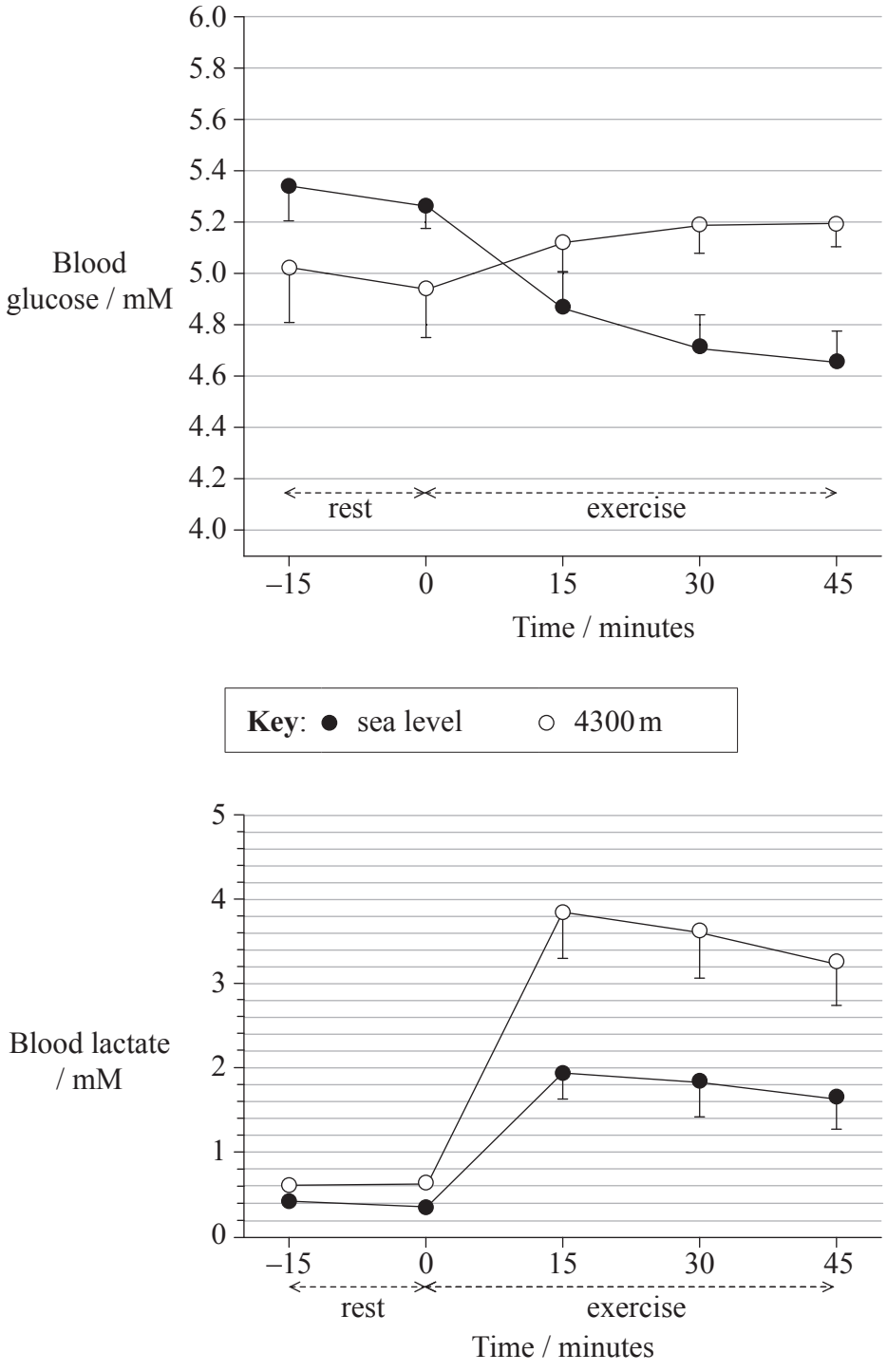
Option H — Further human physiology

H1. Sixteen women were studied to evaluate blood glucose and blood lactate levels while exercising at sea level and at high altitude, 4300 m above sea level.



[Source: Figure 6 from Barry Braun, Jacinda T. Mawson, Stephen R. Muza, Shannon B. Dominick, George A. Brooks, Michael A. Horning, Paul B. Rock, Lorna G. Moore, Robert S. Mazzeo, Steven C. Ezeji-Okoye, and Gail E. Butterfield, "Women at altitude: carbohydrate utilization during exercise at 4,300 m", *J Appl Physio*l 2000 88: 246-256, © The American Physiological Society]

(This question continues on the following page)

(Question H1 continued)

(a) (i) Calculate the percentage increase in blood lactate concentration after 30 minutes of exercise at 4300 m. *[1]*

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(ii) Suggest a reason for the difference in blood lactate concentration between women exercising at sea level and at high altitude. *[1]*

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(b) Describe the variation in the blood glucose and lactate concentrations in the women at sea level. *[2]*

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(c) Analyse the effect of high altitude on the blood glucose and lactate levels. *[3]*

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H2. (a) Outline mechanisms used by the ileum to absorb amino acids. *[2]*

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(b) State **two** materials which are not absorbed in the ileum. *[1]*

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H3. (a) Outline factors that affect the incidence of coronary heart disease. *[5]*

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(b) Discuss the roles of gastric acid and *Helicobacter pylori* in the development of stomach ulcers and cancers. *[5]*

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